Four new species of *Pelargonium* (Geraniaceae) from the western Cape Province

Elizabeth M. Marais
Department of Botany, University of Stellenbosch, Stellenbosch, 7600 Republic of South Africa

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Pelargonium aciculatum E.M. Marais, *P. confertum* E.M. Marais, *P. fasciculaceum* E.M. Marais and *P. connivens* E.M. Marais are described as new species. All four are tuberous species, belonging to the section *Hoarea* (Sweet) DC. They correspond on account of their leaf structure and the structure of the androecium. The pollen morphology and the leaf anatomy support this close relationship of the four species. An illustration of each species and a distribution map are provided.

P. aciculatum E.M. Marais, *P. confertum* E.M. Marais, *P. fasciculaceum* E.M. Marais en *P. connivens* E.M. Marais word as nuwe spesies beskryf. Al vier is geofiete wat aan die seksie *Hoarea* (Sweet) DC. behoort. Morfologies toon die vier spesies ooreenkoms wat betref die blaarstruktuur sowel die struktuur van die andresium. Die stuifmeelmorfologie en die blaaranatomie ondersteun die noue verwantskap tussen die vier spesies. 'n Illustrasie van elke spesie en 'n verspreidingskaart word voorsien.

Keywords: Geraniaceae, *Hoarea, Pelargonium*, southern Africa, taxonomy

Introduction

The section *Hoarea* (Sweet) DC. of the genus *Pelargonium* L'Hérit. consists of deciduous geophytes with regularly shaped tubers with numerous dark brown peeling tunics or periderms, and apically a dense crown of numerous petiole remains. The tuber is a root with apically a short flattened stem from which the leaves and scape emerge (Marais 1989). Most of the species flower in summer after the leaves have been shed. This results in very poor herbarium specimens and therefore specimens without leaves or without flowers are quite common. Species of this section usually occur in very small populations, and this factor also contributes to the poor herbarium record of many of the species in this section. In the case of the four new species described here, the only known collections made before the publication of Knuth's revision of *Pelargonium* in 1912, are those of *P. confertum* E.M. Marais which were collected twice by H.H.W. Pearson in 1910 and both these specimens are without leaves. *P. aciculatum* E.M. Marais was collected at Langebaan in 1932 (a specimen without flowers) and near Vredenburg in 1966. The remaining two species have been collected since the beginning of the *Pelargonium* research project at the University of Stellenbosch in 1975. Proper specimens of all four species were prepared from plants collected in the field and cultivated in the garden. Leaves and flowers were collected at different stages. The pollen morphology and leaf anatomy of the four species are also compared.

Pelargonium aciculatum *E.M. Marais*, sp. nov.

Herba perennis acaulescens tuberosa. *Tuber* subterraneum, elongatum, 80–100 mm longum, ca. 20 mm crassum. *Folia* hysterantha, erecta, petiolata; lamina elliptica, 100–140 mm longa, 35–80 mm lata, irregulariter pinnatilobata vel pinnatisecta, dense hirsuta et glandulosa; petiolus 50–130 mm longus, rigidus, hirsutus; stipulae petioli adnatae. *Inflorescentia*: scapus, pseudoumbellae 2–4, 13–32(–40)-florae. *Pedicelli* ca. 1 mm longi. *Hypanthium* 12–16 mm longum, pilosum et glandulosum. *Sepala* 5, lanceolata, 7–9 mm longa, 1.5–3 mm lata, posterius erectum, cetera recurvata. *Petala* 5, cremea vel pallida flava, duo postica ligulata, 11–13.5 mm longa, subtiliter carmineo-rubra picta, tria antica spathulata, 9–10 mm longa. *Stamina* fertilia 5, staminodia 5.

TYPUS.— Cape Province: Bothmas Kloof, near Riebeek Kasteel, *Marais 318* (STE, holotypus; K, PRE, isotypi).

A deciduous geophyte with a subterranean tuber, leaves erect, 100–300 mm high when in flower. *Tuber*: elongated, branched roots, sometimes with more than one stem-growing point, covered with dark brown periderms, 80–100 mm long and *ca.* 20 mm in diameter. *Leaves*: radical, petiolate, green; lamina elliptic, 100–140 × 35–60(–80) mm, irregularly deeply pinnatilobed to pinnatisect, densely hirsute with distally appressed hairs and glandular hairs interspersed; segments linear, 6–12 mm wide, apices acute, margins serrate; petiole 50–130 mm long, rigid, hirsute with coarse hairs and glandular hairs interspersed; stipules subulate, 18–25 mm long and 2 mm wide, ciliate, adnate to the petiole with apices free; free apices *ca.* 8 mm long. *Inflorescence*: scape 60–130 mm long and 2–3.5 mm in diameter, light green, densely pilose with curly hairs interspersed with long glandular hairs, branched, bearing 2–4 pseudo-umbellets; peduncles 50–130 mm long and 1–1.5 mm in diameter, indumentum as on scape; bracts irregular in form and size, densely hirsute with appressed hairs; pseudo-umbellet 13–32(–40)-flowered, subtended by a whorl of spathulate bracts; bracts 3–5 mm long, acuminate, adaxially hirsute with appressed hairs, abaxially hirsute with appressed hairs and interspersed with glandular hairs, initially erect, recurved during senescence; flower buds, flowers and fruits erect. *Pedicel ca.* 1 mm long. *Hypanthium* 12–16 mm long (about twice as long as the calyx), light green, indumentum as on scape. *Sepals* 5, 7–9 × 1.5–3 mm, posterior one erect, others recurved, lanceolate, apices acuminate, light green, indumentum abaxially as on scape, only less dense. *Petals* 5, pale yellow or cream-coloured, claws orientated close together forming a sheath-like structure; posterior two ligulate, 11–13.5 × 2–3.5 mm, curved laterally, with feather-like red markings, bases

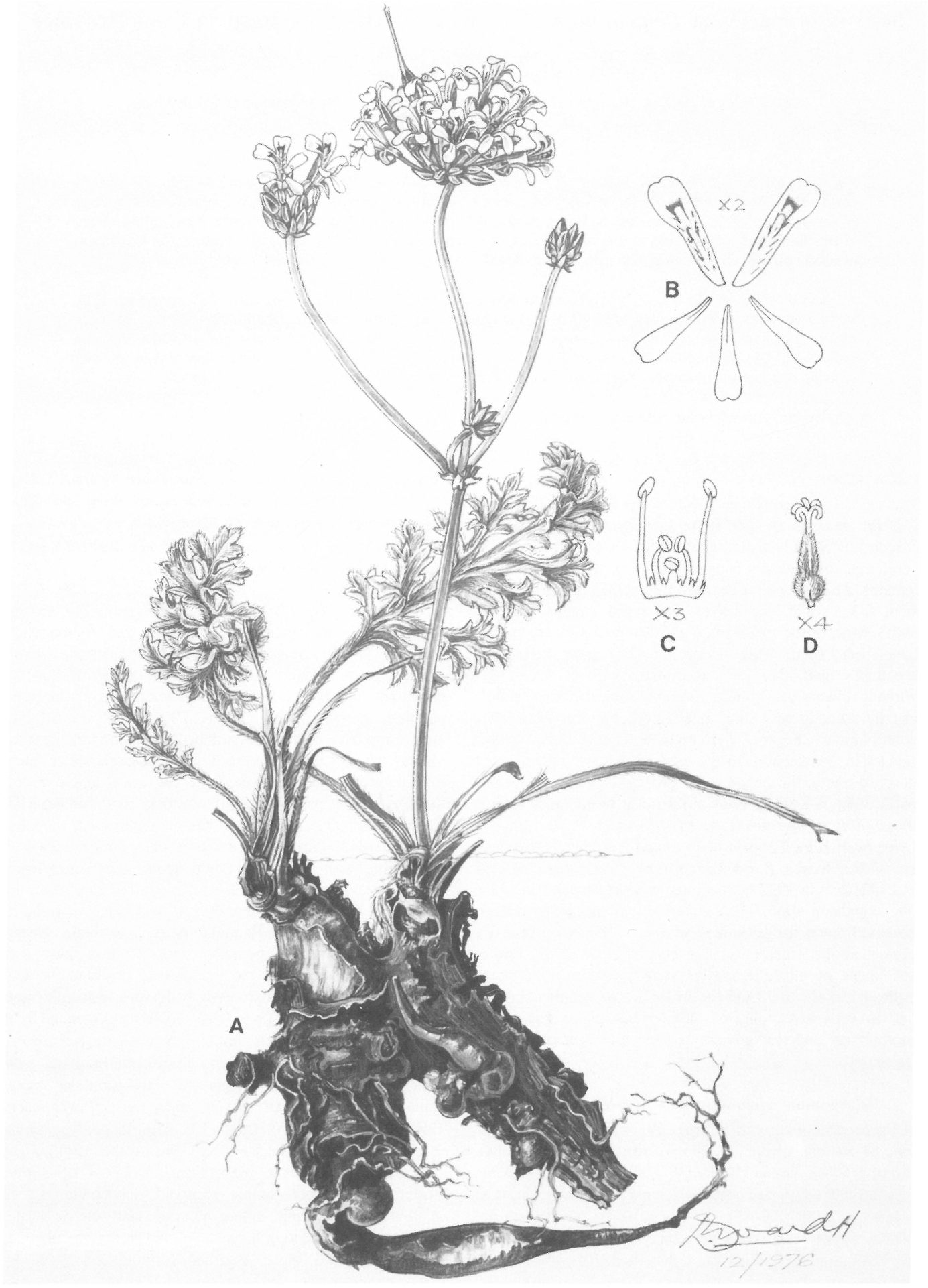

Figure 1 *Pelargonium aciculatum.* A, flowering plant × 1; B, petals × 2; C, androecium × 3; D, gynoecium × 4.

cuneate, apices rounded to emarginate, laterally recurved during anthesis; anterior three spathulate, 9–10 × 2–2.5 mm, dimly marked pink at the very base, bases narrowly cuneate, apices rounded to emarginate, patent during anthesis. *Stamens* 10, basally connate, staminal column 1–2 mm long, white; perfect stamens 5, posterior one *ca.* 1 mm long, lateral two 2 mm long, recurved so that anthers are borne on the same level as posterior one, anterior two 6.5–8 mm long, protruding from the flower, free filaments dark pink; staminodes *ca.* 2.5 mm long; anthers 1 mm long, dark pink, opening with longitudinal slits, pollen orange. *Gynoecium*: ovary superior, oblong-conical, 5-lobed, 4.5 mm long, densely sericeous, green; style filiform, 3–4 mm long, dark pink; stigma with 5 branches, branches 1 mm long, dark pink. *Fruit*: a schizocarp consisting of 5 mericarps, bases of mericarps *ca.* 4 mm long and tails *ca.* 23 mm long (Figure 1).

Diagnostic features

P. aciculatum is a geophyte with erect leaves and rigid petioles. The laminae are irregularly deeply pinnatilobed to pinnatisect and densely hirsute with appressed hairs. The hypanthia of the small yellow flowers are about twice the length of the calyx. There are five fertile stamens, of which the posterior one and the lateral two are very short and concealed within the floral sheath. The lateral two are recurved so that the anthers are borne on the same level as that of the posterior one. The anterior two stamens are about the same length as the calyx and protrude from the flower. The petals are about 1.5 times the length of the calyx, with wine-red feather-like markings on the posterior two. The specific epithet refers to the irregular fine streaks on the petals. It flowers in summer, from November to December.

Geographical distribution and habitat

P. aciculatum occurs on foothills in renosterveld and is restricted to the west coast (Figure 5) from Paleisheuwel in the north to Riebeek Kasteel in the south, an area receiving an annual rainfall of 200–400 mm, mainly during winter.

Specimens examined

—3218 (Clanwilliam): Paleisheuwel (–BC), *Van der Walt 1024* (STEU); Nooitgedacht farm near Vredenburg (–CC), *Barker 10230* (NBG); De Hoek, on Die Kasteel road (–DC), *Marais 265* (STEU); De Hoek, Cement Factory (–DD), *Esterhuysen 20167* (BOL).

—3318 (Cape Town): Langebaan (–AA), *Lewis s.n.* (BOL); *Ward-Hilhorst s.n.* (STEU); Bothmas Kloof, near Riebeek Kasteel (–BD), *Marais 318* (K, PRE, STE, type collection); Voorspoed, Malmesbury (–BD), *Van der Walt 1039* (STEU).

Pelargonium confertum *E.M. Marais*, sp. nov.

Herba perennis acaulescens tuberosa. *Tuber* subterraneum, elongatum, ca. 70 mm longum, 15–30 mm crassum. *Folia* hysterantha, erecta, petiolata; lamina elliptica vel ovata, 90–180 mm longa, 40–110 mm lata, irregulariter bipinnata, dense hirsuta et glandulosa; petiolus 35–60 mm longus, rigidus, curvatus, hirsutus; stipulae petioli adnatae. *Inflorescentia*: scapus, pseudoumbellae 2–8, 13–24(–40)-florae. *Pedicelli* ca. 1 mm longi. *Hypanthium* 11–17 mm longum, curvatum, pilosum et glandulosum. *Sepala* 5, lanceolata, 6–8 mm longa, 1–2 mm lata, posterius erectum, cetera recurvata. *Petala* 5, cremea vel pallida flava, duo postica ligulata, 9–11 mm longa, subtiliter carmineo-rubra picta, tria antica spathulata, 7–9.5 mm longa. *Stamina* fertilia 2, 8 mm longa, staminodia 8.

TYPUS.— Cape Province: Darter's Grave, 13 km S. of Kamieskroon, *Van Jaarsveld 4283* (STE, holotypus; K, PRE, isotypi).

A deciduous geophyte with a subterranean tuber, leaves erect, 140–300 mm high when in flower. *Tuber*: elongated, branched roots, sometimes with more than one stem-growing point, covered with dark brown periderms, 70 mm long and 15–30 mm in diameter. *Leaves*: radical, petiolate, green; lamina elliptic to ovate, 90–180 × 40–80(–110) mm, irregularly bipinnate, densely hirsute with distally appressed hairs and with glandular hairs interspersed; segments linear, 5–12 mm wide, apices acute, margins serrate; petiole 35–60 mm long, rigid, conspicuously curved, hirsute with appressed coarse hairs and short glandular hairs interspersed; stipules subulate, 13–20 mm long and 2 mm wide, hirsute to densely hirsute at the apex, adnate to the petiole with apices free, free apices *ca.* 5 mm long. *Inflorescence*: scape 40–200 mm long and 3–5 mm in diameter, light green, densely pilose with curly hairs interspersed with long glandular hairs, branched, bearing 2–8 pseudo-umbellets; peduncles 70–150 mm long and 1–2 mm in diameter, indumentum as on scape; bracts irregular in form and size, densely hirsute; pseudo-umbellet 13–24(–40)-flowered, subtended by a whorl of ovate bracts; bracts 4–5 mm long and *ca.* 1.5 mm wide, acute, abaxially hirsute with appressed hairs and interspersed with glandular hairs; flower buds, flowers and fruits erect. *Pedicel ca.* 1 mm long. *Hypanthium* 11–17 mm long (twice as long as the calyx), curved, light green, indumentum as on scape. *Sepals* 5, 6–8 × 1–2 mm, posterior one erect, others recurved, lanceolate, apices acuminate, light green, indumentum abaxially as on scape, only less dense. *Petals* 5, pale yellow or cream-coloured, claws orientated close together forming a sheath-like structure; posterior two, ligulate, 9–11 × 2–3 mm, with feather-like red markings, bases cuneate, apices round, laterally recurved during anthesis; anterior three spathulate, 7–9.5 × 1–2 mm, with red markings at the very base, bases attenuate, apices round, patent during anthesis. *Stamens* 10, basally connate, staminal column *ca.* 1 mm long, white; perfect stamens 2, 8 mm long, protruding from the flower, free filaments white; staminodes 1–2 mm long, apices pink; anthers 1.5 mm long, pink, opening with longitudinal slits, pollen orange. *Gynoecium*: ovary superior, oblong-conical, 5-lobed, 5.5 mm long, densely sericeous, green; style filiform, 2–4 mm long, pink; stigma with 5 branches, branches 1 mm long, dark red. *Fruit*: a schizocarp consisting of 5 mericarps, bases of mericarps *ca.* 5 mm long and tails *ca.* 22 mm long (Figure 2).

Diagnostic features

P. confertum is a geophyte with erect leaves and rigid, curved petioles. The laminae are irregularly bipinnate and densely hirsute with appressed hairs. The hypanthia of the small yellow flowers are about twice the length of the calyx. The large number of flowers with short hypanthia gives the

Figure 2 *Pelargonium confertum.* A, tuber × 1; B, leaves × 1; C, leaf base × 1; D, androecium × 4; E, gynoecium × 6; F, inflorescence × 1; G, petals × 3.

inflorescence a crowded appearance, hence the specific epithet. Only the anterior two stamens are fertile and they are the same length as the calyx and protrude from the flower. The petals are about 1.5 times the length of the calyx, with wine-red feather-like markings on the posterior two. It flowers from November to December.

Geographical distribution and habitat

P. confertum occurs in small populations in rock crevices or under bushes in Namaqualand (Figure 5), from Rietkloof Mountains near Steinkopf in the north to Nuwerus in the south, an area receiving an annual rainfall of 100–200 mm mainly during winter.

Specimens examined

—2917 (Springbok): Northern slopes of Rietkloof Mountains (–BC), *Pearson 5703* (BOL, K); Spektakel Pass (–DA), *Van der Walt 956* (STEU).

—3017 (Hondeklipbaai): Darter's Grave, 13 km S. of Kamieskroon (–BD), *Van Jaarsveld 4283* (K, PRE, STE, type collection).

—3018 (Kamiesberg): 16 km from Garies to Leliefontein (–AC), *Marais 72* (STEU).

—3118 (Vanrhynsdorp): Between Nuwerus and Bitterfontein (–AB), *Pearson 5541* (BOL, K).

Pelargonium fasciculaceum *E.M. Marais*, sp. nov.

Herba perennis acaulescens tuberosa. *Tuber* subterraneum, elongatum, 70–110 mm longum, 15–25 mm crassum. *Folia* hysterantha, erecta, petiolata; lamina ovata, 140–270 mm longa, 60–120 mm lata, irregulariter bipinnata, dense hirsuta et glandulosa; petiolus 80–200 mm longus, rigidus, hirsutus; stipulae petioli adnatae. *Inflorescentia*: scapus, pseudoumbellae 4–8, 15–26(–40)-florae. *Pedicelli* ca. 1 mm longi. *Hypanthium* 40–60 mm longum, pilosum et glandulosum. *Sepala* 5, 7–9 mm longa, 1.5–3 mm lata, posterius triangulare erectum, cetera lanceolata, recurvata. *Petala* 5, cremea vel pallida flava, duo postica oblanceolata, 16–19 mm longa, notis V-formibus carmineo-rubris picta, tria antica oblanceolata, 13–16 mm longa. *Stamina* fertilia 5, staminodia 5.

TYPUS.— Cape Province: Arbeidsgenot, on gravelled road between Citrusdal and Clanwilliam, *Marais 184* (STE, holotypus; BOL, K, PRE, isotypi).

A deciduous geophyte with a subterranean tuber, leaves erect, 300–500 mm high when in flower. *Tuber*: elongated, branched roots, sometimes with several stem-growing points, covered with dark brown periderms, 70–110 mm long and 15–25 mm in diameter. *Leaves*: radical, petiolate, green; lamina ovate, 140–270 × 60–120 mm, irregularly bipinnate, densely hirsute with distally appressed hairs and with glandular hairs interspersed; segments linear, 4–8 mm wide, apices acute, margins serrate; petiole 80–200 mm long, rigid, hirsute with coarse hairs and interspersed with glandular hairs; stipules subulate, 15–25 mm long and 2 mm wide, hirsute to densely hirsute at the apex, adnate to the petiole with apices free; free apices *ca.* 5 mm long. *Inflorescence*: scape 70–170 mm long and 2–5 mm in diameter, light green, densely pilose with curly hairs interspersed with long glandular hairs, branched, bearing 4–8 pseudo-umbellets; peduncles 90–240 mm long and 1.5–3 mm in diameter, indumentum as on scape; bracts irregular in form and size, densely hirsute; pseudo-umbellet 15–26(–40)-flowered, subtended by a whorl of narrowly triangular bracts; bracts 4–5 mm long, acuminate, abaxially hirsute with appressed hairs and interspersed with glandular hairs, initially erect, recurved during senescence; flower buds, flowers and fruits erect. *Pedicel ca.* 1 mm long. *Hypanthium* 40–60 mm long, (6–8 times the length of the calyx), light green, indumentum as on scape. *Sepals* 5, 7–9 × 1.5–3 mm, posterior one erect, others recurved, posterior one triangular, remaining four lanceolate, apices acuminate, light green, indumentum abaxially as on scape, only less dense. *Petals* 5, oblanceolate, bases cuneate, apices rounded to emarginate, pale yellow or cream-coloured, claws orientated close together forming a sheath-like structure; posterior two 16–19 × 3–4 mm, with V-shaped red markings, apices laterally recurved during anthesis; anterior three 13–16 × 2–3 mm, dimly marked pink at the very base, apices patent during anthesis. *Stamens* 10, basally connate, staminal column 1.5–2 mm long, white; perfect stamens 5, posterior one *ca.* 2 mm long, lateral two 4 mm long, recurved so that anthers are borne on the same level as posterior one, anterior two 9–11 mm long, protruding from the flower, free filaments dark pink; staminodes *ca.* 2.5 mm long; anthers 1 mm long, dark pink, opening with longitudinal slits, pollen orange. *Gynoecium*: ovary superior, oblong-conical, 5-lobed, 3 mm long, densely sericeous, green; style filiform, 2 mm long, dark red; stigma with 5 branches, branches 1 mm long, dark red. *Fruit*: a schizocarp consisting of 5 mericarps, bases of mericarps *ca.* 5 mm long and tails *ca.* 23 mm long (Figure 3).

Diagnostic features

P. fasciculaceum is a geophyte with very large erect leaves and rigid petioles. The laminae are irregularly bipinnate and densely hirsute with appressed hairs. With the long scapes and peduncles this species is up to 0.5 m high when in flower, and it is therefore one of the tallest species in section *Hoarea*. The hypanthia of the pale yellow flowers are about six to eight times the length of the calyx. There are five fertile stamens, of which the posterior one and the lateral two are very short and concealed within the floral sheath. The lateral two are recurved so that the anthers are borne on the same level as that of the posterior one. The anterior two stamens are longer than the calyx and protrude from the flower. The petals are about twice the length of the calyx, with red V-shaped markings on the posterior two. The specific epithet refers to the large number of flowers with long hypanthia diverging from a common centre.

Geographical distribution and ecology

P. fasciculaceum grows in sandy places along the banks of the Olifants River and its tributaries and in mountain fynbos on the Nardous and Bokkeveld plateaux (Figure 5), an area receiving an annual rainfall of 200–400 mm, occurring mainly during winter. The fleshy roots are branched, forming an extensive root system on which several stem-growing points develop. Thus older plants often grow in colonies while younger and smaller plants usually grow

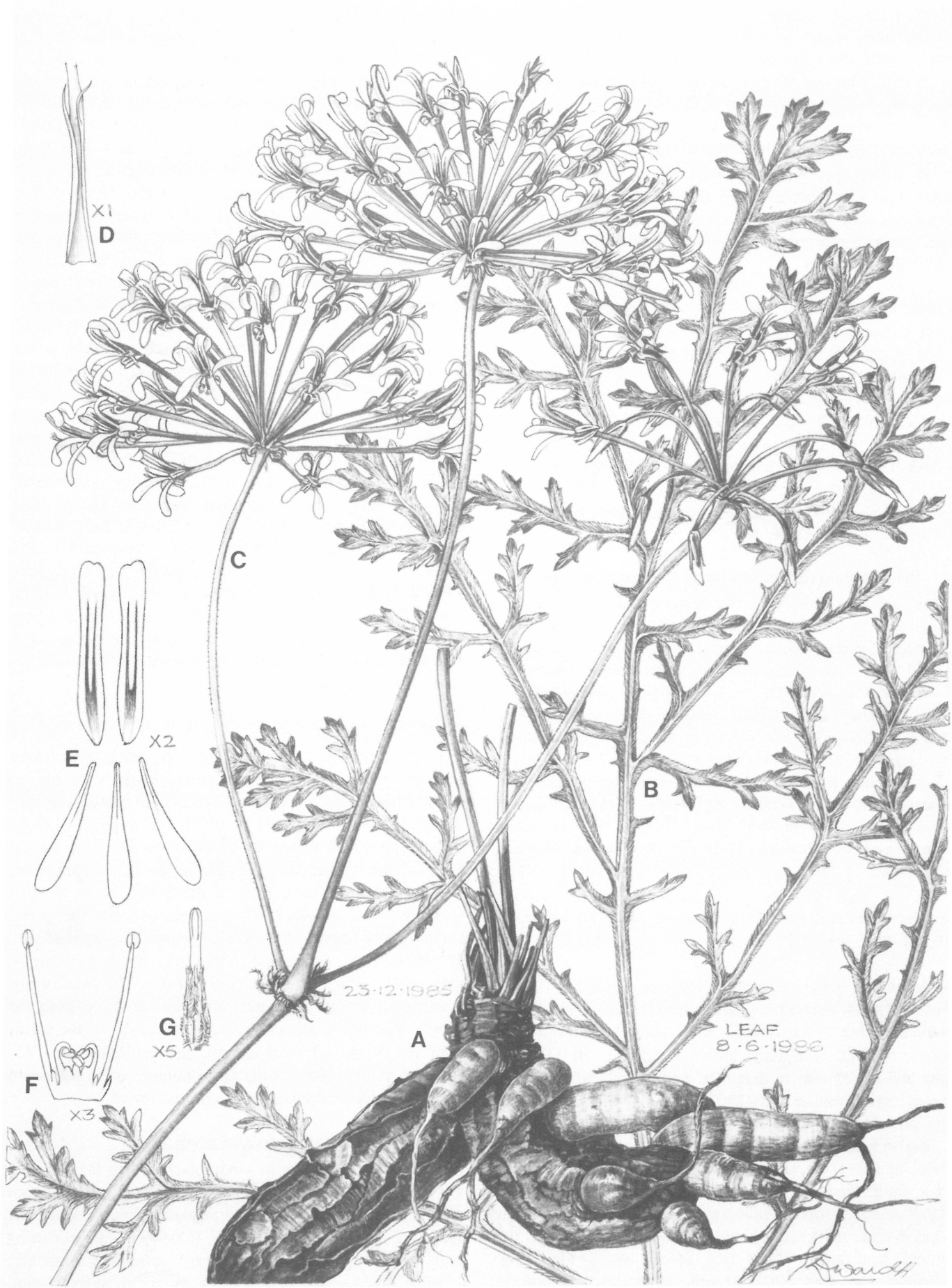

Figure 3 *Pelargonium fasciculaceum.* A, tuber × 1; B, leaf × 1; C, inflorescence × 1; D, leaf base × 1; E, petals × 2; F, androecium × 3; G, gynoecium × 5.

singly, an indication that in nature plants easily develop from seeds. It flowers in summer, from December to January after the leaves have been shed. Each of the numerous scapes per plant bears four to eight pseudo-umbellets which mature in succession, thus lengthening the flowering season. Fruit setting under cultivated conditions is rare. This, as well as the special structure of the androecium indicates a dependance on a special pollinator.

Plants from the Nardous and Bokkeveld plateaux, areas with a lower annual rainfall than along the Olifants River, flower only late in January and usually have fewer pseudo-umbellets per scape and fewer flowers per pseudo-umbellet than those from the Olifants River valley. Plants from the Olifants River valley flower from December to January.

Specimens examined

—3118 (Vanrhynsdorp): Vleikraal, 8 km E. of Klawer (–DA), *Walters 1* (STEU); Muggiedraai turnoff, on Nardous Pass road (–DD), *Marais 325* (STEU); On top of Giftberg (–DD), *Van Jaarsveld 4363* (STEU).

—3119 (Calvinia): Papkuilsfontein, S. of Nieuwoudtville (–CA), *Von Willert s.n.* (STEU).

—3218 (Clanwilliam): Arbeidsgenot on gravelled road between Citrusdal and Clanwilliam (–BD), *Marais 184* (BOL, K, PRE, STE, type collection); Haarwegskloof (–BD), *Marais 199* (STEU); Melkboomfontein on the banks of the Olifants River (–BD), *Marais 266* (STEU); 6 km from Paleisheuwel turnoff (–BD), *Van der Walt 1046* (STEU).

Pelargonium connivens *E.M. Marais*, sp. nov.

Herba perennis acaulescens tuberosa. *Tuber* subterraneum, elongatum, ca. 40 mm longum, ca. 20 mm crassum. *Folia* hysterantha, erecta, petiolata; lamina elliptica vel ovata, 100–130 mm longa, 40–60 mm lata, irregulariter pinnatisecta, dense hirsuta et glandulosa; petiolus 45–70 mm longus, rigidus, hirsutus; stipulae petioli adnatae. *Inflorescentia*: scapus, pseudoumbellae 2–3, 10–30-florae. *Pedicelli* ca. 1 mm longi. *Hypanthium* 40–55 mm longum, pilosum et glandulosum. *Sepala* 5, 10 mm longa, 1.5–3 mm lata, recurvata, posterius lineari-triangulare, cetera lanceolata. *Petala* 5, cremea, connivent, duo postica ligulata, 24–28 mm longa, notis V-formibus roseis, tria antica ligulata vel spathulata, 20–24 mm longa. *Stamina* fertilia 5, staminodia 5.

TYPUS.— Cape Province: Rondekop, Nieuwoudtville, *Lavranos & Pehlemann 19000* (STE, holotypus; K, PRE, isotypi).

A deciduous geophyte with a subterranean tuber, leaves erect, 180 mm high when in flower. *Tuber*: elongated, branched roots, with a short flattened stem, covered with dark brown periderms, *ca.* 40 mm long and *ca.* 20 mm in diameter. *Leaves*: radical, petiolate, green; lamina elliptic to ovate, 100–130 × 40–60 mm, irregularly pinnatisect, densely hirsute with distally appressed hairs and with glandular hairs interspersed; segments linear, 6–12 mm wide, apices acute, margins serrate; petiole 45–70 mm long, rigid, hirsute with appressed coarse hairs and short glandular hairs interspersed; stipules subulate, 7–14 mm long and 1.5 mm wide, hirsute to densely hirsute at the apex, adnate to the petiole with apices free, free apices *ca.* 3 mm long. *Inflorescence*: scape 30–40 mm long and 2–3 mm in diameter, light green, densely pilose with curly hairs interspersed with long glandular hairs, branched, bearing 2–3 pseudo-umbellets; peduncles 35–70 mm long and 1.5–2 mm in diameter, indumentum as on scape; bracts irregular in form and size, densely hirsute; pseudo-umbellet 10–30-flowered, subtended by a whorl of subulate bracts; bracts 3–4 mm long, abaxially hirsute with appressed hairs and interspersed with glandular hairs, initially erect, recurved during senescence; flower buds, flowers and fruits erect. *Pedicel ca.* 1 mm long. *Hypanthium* 40–55 mm long (4–5 times the length of the calyx), light green, indumentum as on scape. *Sepals* 5, 10 × 1.5–3 mm, recurved, posterior one narrowly triangular, remaining four lanceolate, apices acuminate, light green, indumentum abaxially as on scape, only less dense. *Petals* 5, cream-coloured to salmon-pink, connivent, forming a sheath-like structure, bases cuneate, apices round; posterior two ligulate, slightly curved, 24–28 × 4 mm, with V-shaped pink markings, apices slightly recurved during anthesis; anterior three ligulate to spathulate, 20–24 × 2–2.5 mm, dimly marked pink at the very base, apices patent during anthesis. *Stamens* 10, basally connate, staminal column 1.5–2 mm long, white; perfect stamens 5, posterior one *ca.* 2.5 mm long, lateral two 4 mm long, erect, anterior two 10 mm long, free filaments white; staminodes *ca.* 2.5 mm long; anthers *ca.* 1 mm long, dark pink, opening with longitudinal slits, pollen orange. *Gynoecium*: ovary superior, oblong-conical, 5-lobed, 3 mm long, densely sericeous, green; style filiform, 4.5 mm long, pink; stigma with 5 branches, pink. *Fruit*: a schizocarp consisting of 5 mericarps, bases of mericarps *ca.* 5 mm long and tails *ca.* 23 mm long (Figure 4).

Diagnostic features

P. connivens is a geophyte with erect leaves and rigid petioles. The laminae are irregularly pinnatisect and densely hirsute with appressed hairs. The hypanthia of the cream-coloured to salmon-pink flowers are about four to five times the length of the calyx. There are five fertile stamens, of which the posterior one and the lateral two are very short and the lateral two are erect. The anterior two stamens are more or less the same length as the calyx. The petals are 2.5 to three times the length of the calyx, connivent, forming a sheath-like structure in which all the stamens are concealed, hence the specific epithet. The pink V-shaped markings on the posterior two petals give the flower a salmon-pink appearance. It flowers from December to January.

Geographical distribution

Only two collections of this species are known, both from Rondekop near Nieuwoudtville (Figure 5). This area receives an annual rainfall of 200–300 mm, mainly during winter.

Specimens examined

—3119 (Calvinia): Rondekop near Nieuwoudtville (–AD), *Lavranos & Pehlemann 19000* (K, PRE, STE, type collection), *Lavranos & Pehlemann 19001* (STEU).

Leaf anatomy

Transverse sections of wax-embedded petioles and laminae of all four species (Table 1) were cut with a rotary

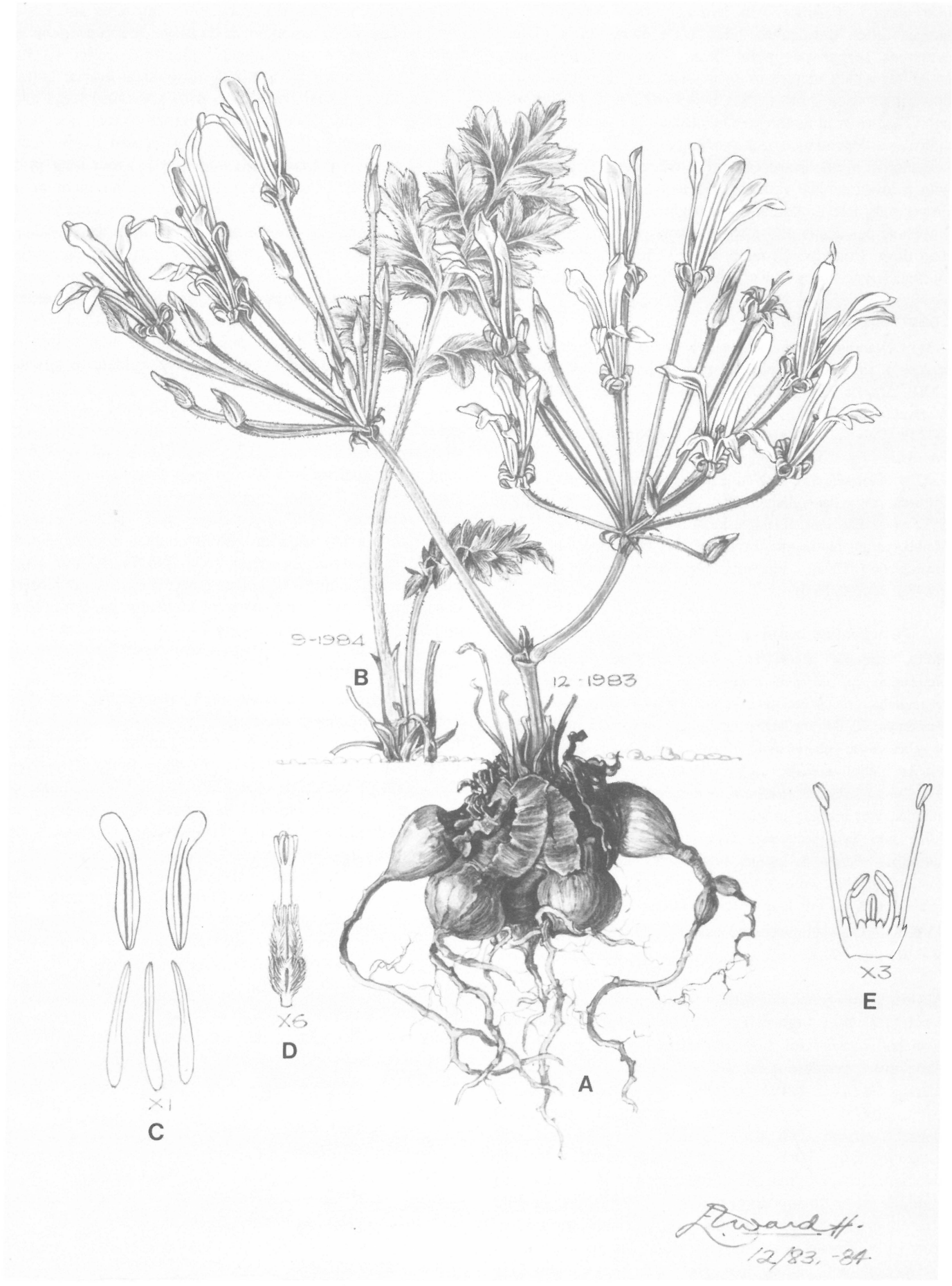

Figure 4 *Pelargonium connivens*. A, flowering plant × 1; B, leaves × 1; C, petals × 1; D, gynoecium × 6; E, androecium × 3.

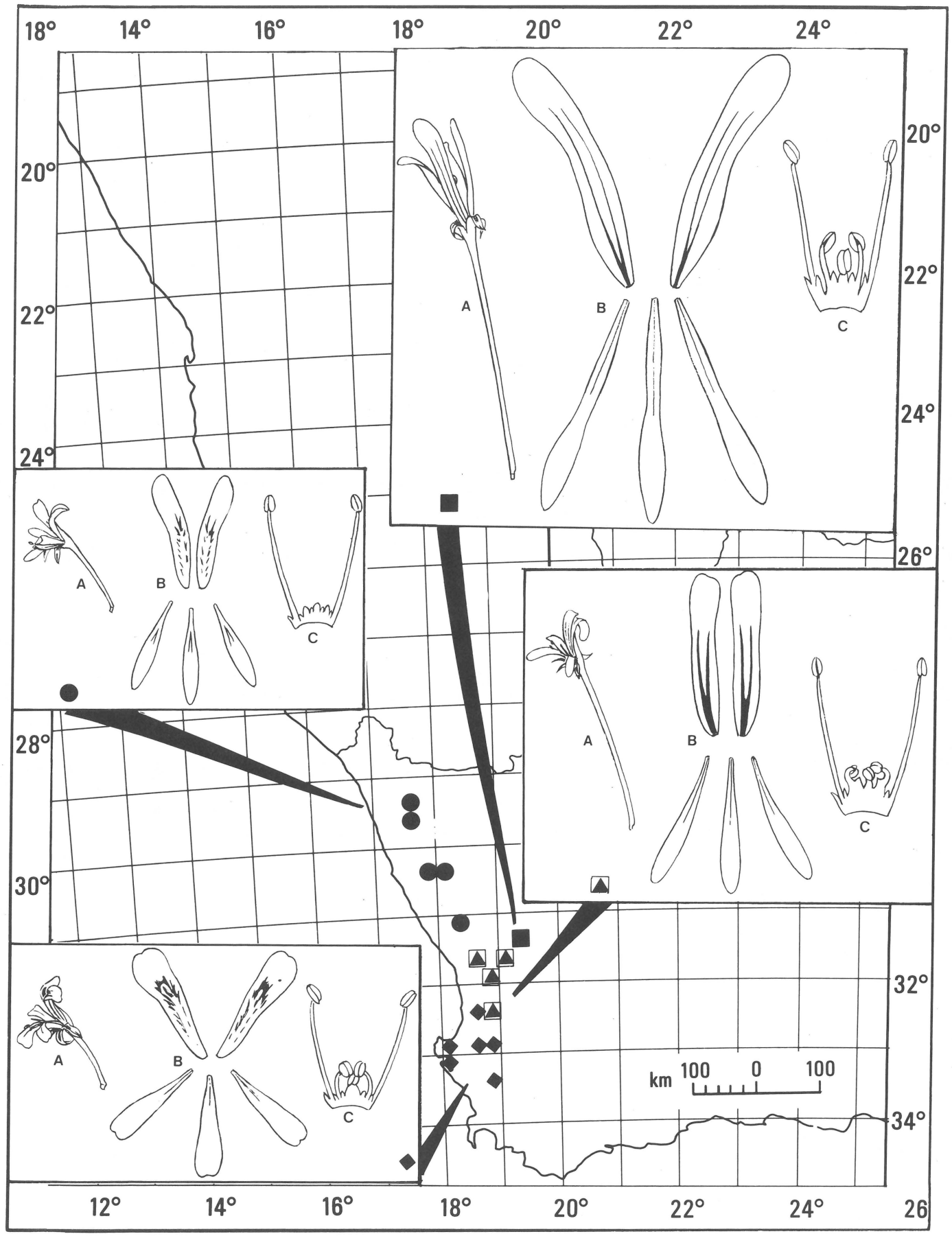

Figure 5 Known geographical distribution of ♦*P. aciculatum*, ●*P. confertum*, ▲ *P. fasciculaceum* and ■ *P. connivens*. A, flower × 1; B, petals × 2; C, androecium × 3.

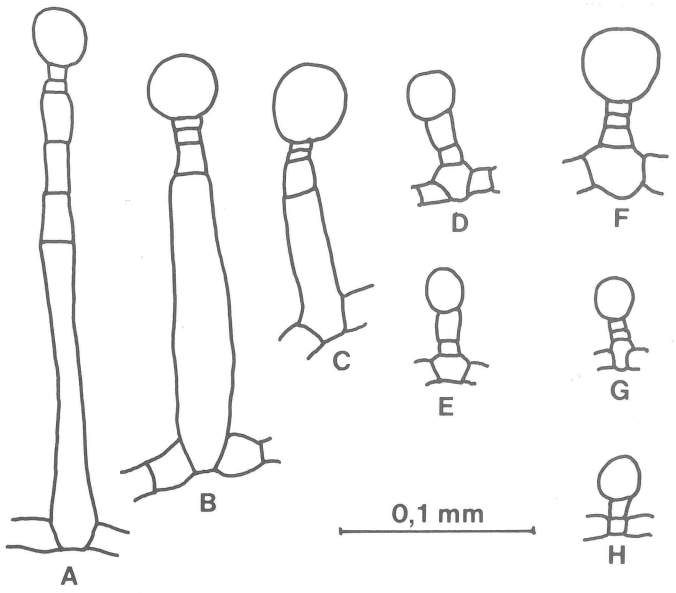

Figure 6 Glandular hairs on the leaves of: A–E, *P. aciculatum* and *P. fasciculaceum*; F–H, *P. confertum* and *P. connivens*.

microtome and stained with Alcian Green Safranin (Joel 1983). Sections were made through the middle part of the petioles and laminae.

The petioles of all four species are more or less circular in transverse section. The epidermis consists of one layer of cells with glandular and non-glandular hairs. The latter vary in length and in *P. confertum* and *P. connivens* they are distally appressed. The glandular hairs consist of uniserial stalks with unicellular spherical heads and vary in length depending on the size of the basal cell (Figure 6). Long glandular hairs (Figure 6A–C) are usually present in *P. aciculatum* and *P. fasciculaceum*, but absent in *P. confertum* and *P. connivens*. The cortex consists of an uniseriate collenchymatous hypodermis and four to six cell layers of chlorenchyma. A continuous cylinder of extraxylary sclerenchyma surrounds the vascular bundles. The vascular tissue consists of a cylinder of four main bundles alternating with a varying number of medium-sized and smaller bundles (Figure 7) and a variable number of medullary bundles. In *P. confertum* and *P. connivens* only one medullary bundle, consisting of one to three fused bundles, is present (Figure 7B, D), whereas in *P. aciculatum* and *P. fasciculaceum* the number of medullary bundles varies from one to several (Figure 7A, C).

The laminae are amphistomatic and the epidermis consists of one layer of cells covered by a thin cuticle. The leaves of all four species are dorsiventral with, adaxially, a single layer of short but broad palisade cells. Druse crystals are scattered throughout the mesophyll. The mesophyll is rather compact with small and few air spaces, a characteristic which is common in leaves of xerophytes (Cutler 1978).

Pollen morphology

Pollen grains of all four species were collected and treated according to the acetolysis method and studied with the light and scanning electron microscope (Table 1). At least twenty pollen grains of each specimen were studied and measured.

Table 1 Specimens studied for leaf anatomy* and pollen morphology

Taxon, specimen	STEU project number	Pollen measurements Min	Max	$\bar{x}$ (µm)
P. aciculatum				
Ward s.n.	STEU 1098*	57	69	61
Van der Walt 1024	STEU 2282*	59	79	70
Van der Walt 1039	STEU 2405*	56	71	65
Marais 265	STEU 3702*	68	76	72
Marais 318	STEU 3872*			
P. confertum				
Van der Walt 956	STEU 2069*	66	81	74
Van Jaarsveld 4283	STEU 2375*	64	79	73
Marais 72	STEU 3317*	67	86	79
P. fasciculaceum				
Van der Walt 1046	STEU 2420*	62	86	74
Marais 184	STEU 3557*	66	74	70
Marais 199	STEU 3632*	74	86	82
Marais 266	STEU 3703*	66	81	74
Von Willert s.n.	STEU 3756	64	79	72
Marais 325	STEU 3880	66	86	75
P. connivens				
Lavranos & Pehlemann 19001	STEU 2817*	59	76	70
Lavranos & Pehlemann 19000	STEU 2824*	71	86	79

The morphology of the pollen grains corresponds to that of the rest of the genus *Pelargonium*, in that the grains are spherical and tricolporate (Marais 1990; Figure 8A). The exine comprises an inner nexine and an outer sexine and each aperture consists of a colpus and an inner pore. In all four species the colpus is clearly distinguishable and comprises the nexine only (Figure 8B). The sexine consists of columellae and a tectum. The latter can be described as striate (Bortenschlager 1967) because the main muri are on a higher level and are ± parallel to one another. These muri are also thicker and much more prominent than the lower connecting ones (Figure 8C). The pollen grains of *P. confertum* (74–79 µm), *P. fasciculaceum* (70–82 µm) and *P. connivens* (70–79 µm) are more or less similar in size and are slightly bigger than those of *P. aciculatum* (61–72 µm; Table 1).

Discussion

The section *Hoarea* represents deciduous geophytes with regularly shaped tubers (Marais 1989). The tubers are roots and each tuber may have one to several stem-growing points. The tubers of the four species described here are elongated branched roots with a variation in the number of stem-growing points. The leaves are similar in that the petioles are erect and rigid and the laminae irregularly incised. There is also a resemblance in the indumentum of the petioles, the laminae and the scapes as well as in the anatomy of the leaves. The latter agrees in respect of the structure of the mesophyll and the continuous cylinder of extraxylary fibres surrounding the cylinder of vascular bundles in the petioles. An outstanding characteristic of the four species is the structure of the androecium. The posterior

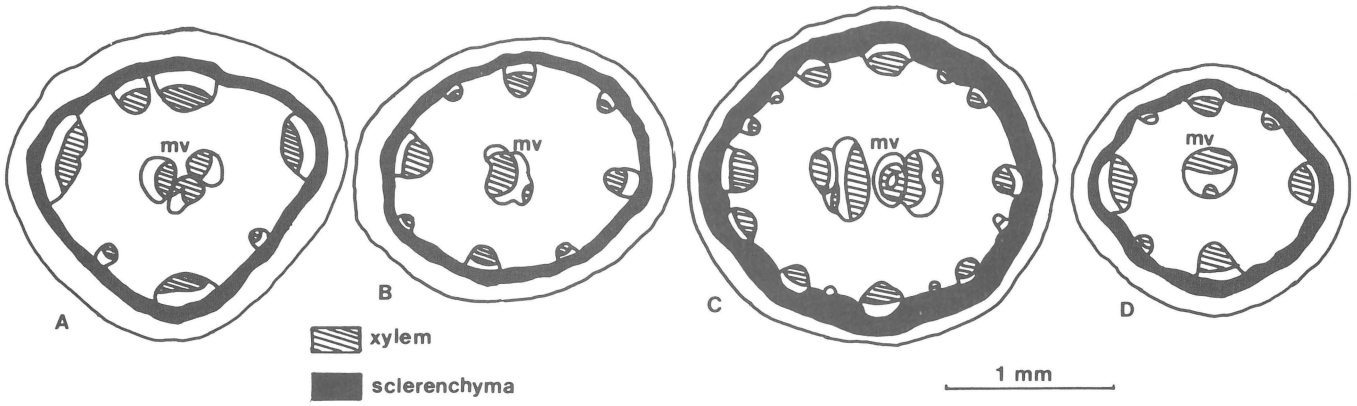

Figure 7 Transverse sections through the middle part of the petiole of: A, *P. aciculatum*; B, *P. confertum*; C, *P. fasciculaceum*; D, *P. connivens*. mv = medullary vascular bundle.

and lateral stamens and staminodes are very short, whereas the anterior two are long and in the case of *P. aciculatum*, *P. confertum* and *P. fasciculaceum* they protrude from the flower. The anthers are very small if compared with those of other species in the section.

P. aciculatum and *P. confertum* can be distinguished from

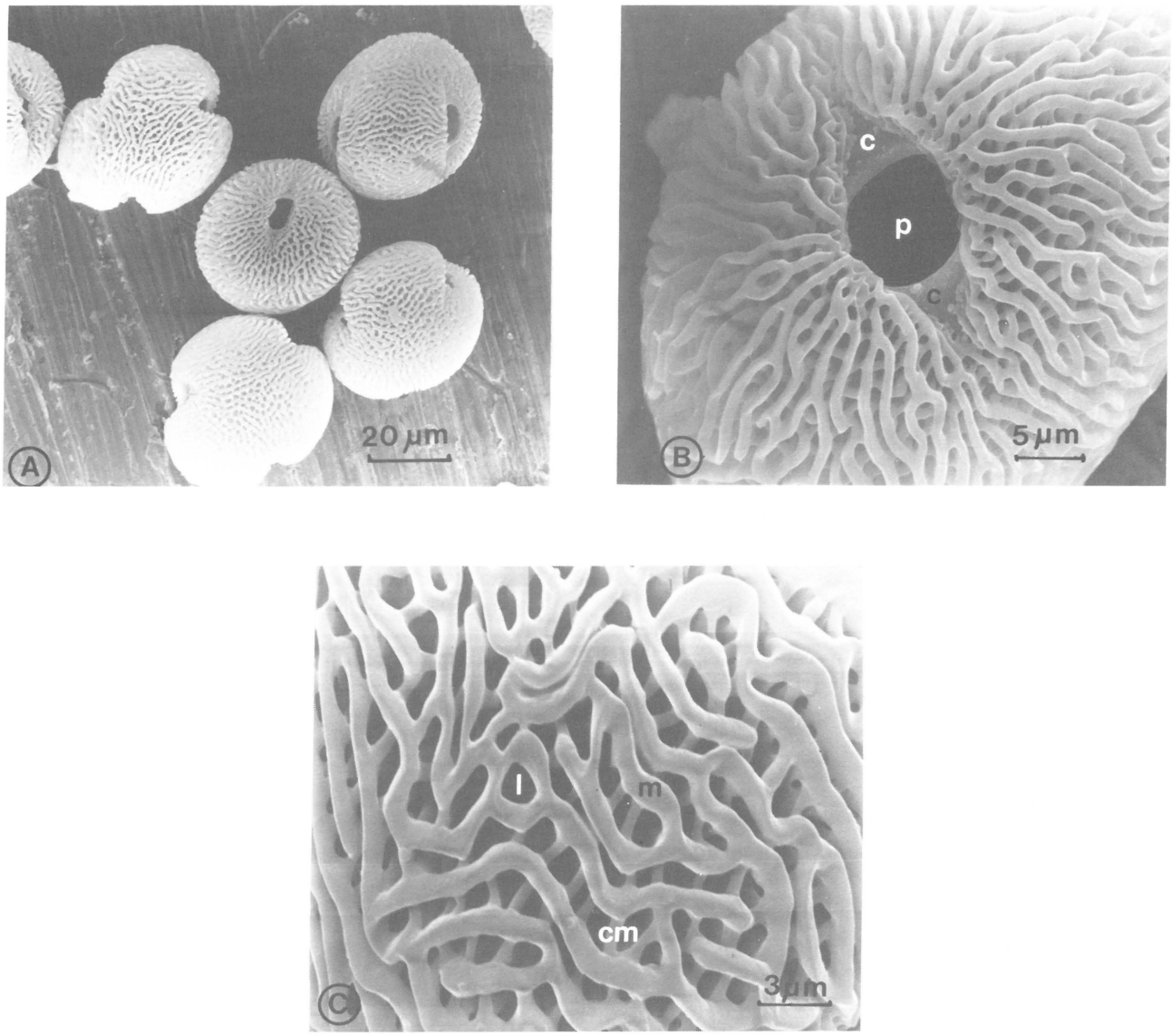

Figure 8 A, pollen grains of *P. aciculatum*; B, aperture of a pollen grain of *P. confertum*; C, mesocolpium of a pollen grain of *P. fasciculaceum*. c = colpus, cm = connecting muri, l = lumen, m = main muri, p = pore.

P. fasciculaceum and *P. connivens* by the length of the hypanthium and the form, size and markings on the petals. In the former two species the hypanthium is only twice the length of the calyx, and the petals are small, with feather-like markings on the posterior two. The peak of the flowering time in this case is in November. In the latter two species the length of the hypanthium is four to eight times that of the calyx, the petals are longer with V-shaped markings on the posterior two and the peak of the flowering time is in January.

Although the flowers of *P. aciculatum* and *P. confertum* are very similar, the latter has only two fertile stamens whereas *P. aciculatum* has five. The two species occupy two separate distribution areas (Figure 5).

P. fasciculaceum with its sometimes extensive root system, exceedingly large erect leaves and several branched scapes per plant, is one of the largest species in the section *Hoarea*. It usually has more pseudo-umbellets per scape and more flowers per pseudo-umbellet than *P. connivens*. It is distinguished from *P. connivens* by its shorter, pale yellow petals with recurved or patent apices instead of the longer salmon-pink, connivent petals of *P. connivens*. The indumentum on the petioles of the two species consists of non-glandular and glandular hairs. In *P. connivens* only short glandular and appressed non-glandular hairs are present, whereas in *P. fasciculaceum* the glandular hairs vary in length (Figure 6) and the non-glandular hairs are erect. The known distribution areas of the two species are adjacent but not overlapping.

The four species described here, can easily be distinguished from one another, but because of the resemblance in the structure of the androecium, leaves and pollen, they can be regarded as a natural taxon within the section *Hoarea*.

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